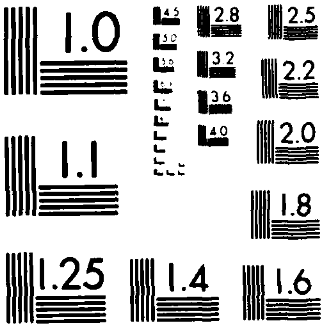
AD-A143 693 DROUGHT CONTINGENCY PLAN WESTVILLE LAKE THAMES RIVER 1/1
BASIN QUINEBAUG RIVER WATERSHED STURBRIDGE
MASSACHUSETTS(U) CORPS OF ENGINEERS WALTHAM MA NEW
UNCLASSIFIED ENGLAND DIV DEC 83 F/G 13/2 NL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US Army Corps
of Engineers
New England Division

Drought Contingency Plan

AD-A143 693

DECEMBER 1983

Westville Lake, Sturbridge, Massachusetts

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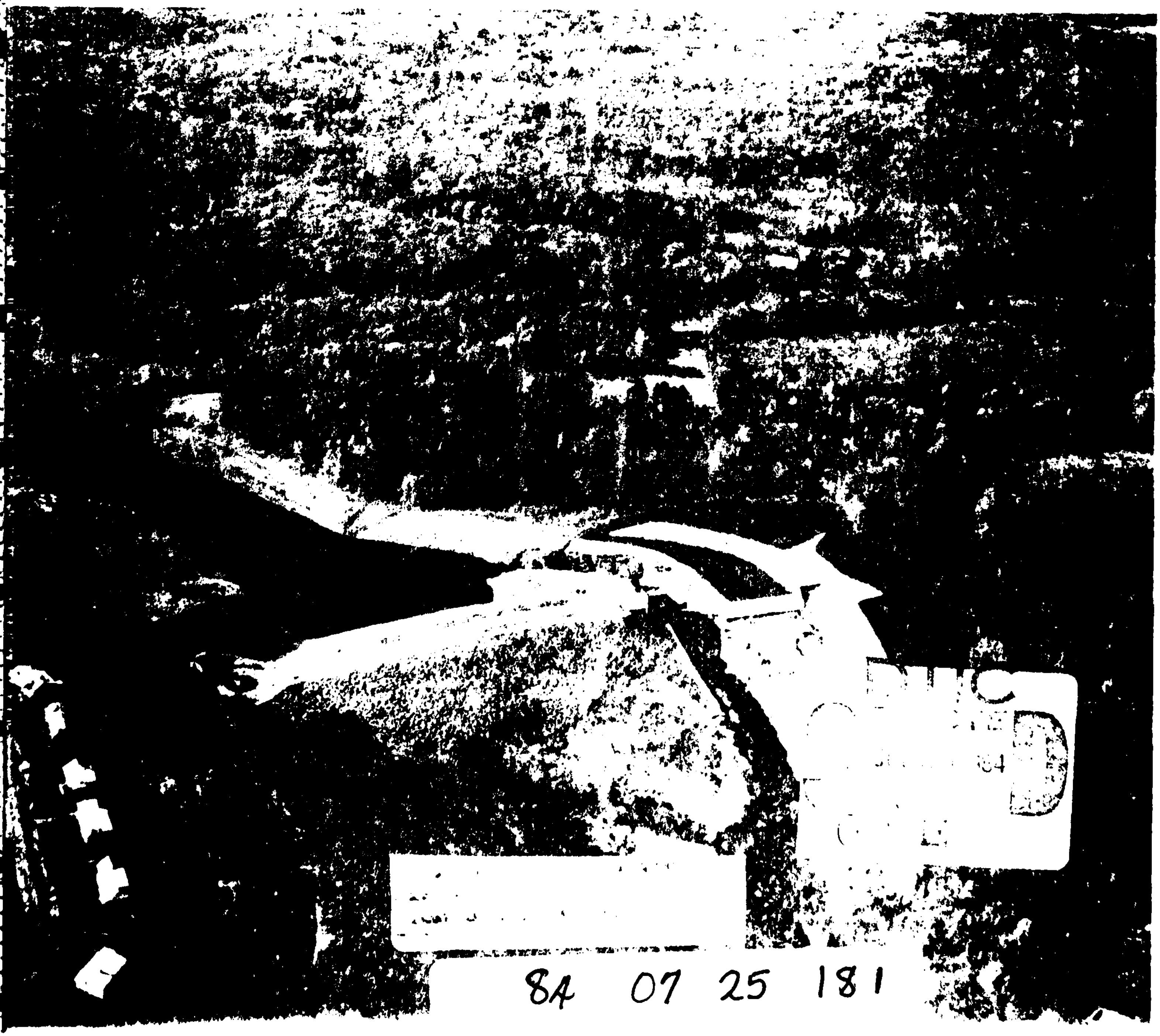

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DROUGHT CONTINGENCY PLAN
WESTVILLE LAKE

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1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency plan of operation for Westville Lake that would be responsive to public needs during droughts and to identify possible modifications to project regulation within current administrative and legislative constraints. This evaluation was based on preliminary studies using readily available information. This drought contingency plan includes a description of existing water supply systems, the possibility of reallocation of reservoir storage within specified limits, water quality evaluation, discussion of impacts on other project purposes, effects on the environment, and summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basinwide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Westville Lake was authorized as a flood control project by the Flood Control Act of 18 August 1941 (Public Law 228, 78th Congress). In addition, Section 4 of the Flood Control Act of 22 December 1944 (Public Law 534, 78th Congress) authorized recreational use of the reservoir area.

4. PROJECT DESCRIPTION

Westville Dam, completed in 1962, is located on the Quinebaug River in the towns of Sturbridge and Southbridge, Massachusetts. A map of the Thames River Basin is shown on plate 1.

The reservoir contains storage for recreation and flood control. The recreation pool at elevation 525 feet NGVD (10-foot stage) contains 100 acre-feet, equal to 0.06 inches of runoff. The flood control storage contains 11,000 acre-feet (3.6 billion gallons) equivalent to 6.4 inches of

runoff from the net drainage area of 32 square miles (total drainage area is 99.5 square miles). An area capacity table is shown on plate 2, and a summary of pertinent data at Westville Lake is contained on plate 3.

Components of the project consist of a rolled earthfill and rock-faced dam, outlet works and concrete spillway. The outlet works are located in the center of the spillway and consist of 3 gated rectangular conduits with inverts at elevation 515 feet. Three 4'-0" wide by 6'-0" high, electrically operated slide gates control the flow through the outlet works. A permanent U-shaped concrete weir containing 5 stoplog openings is located upstream of the center gate and maintains a recreation pool at elevation 525 feet.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. A small permanent pool approximately 10 feet deep is maintained by the concrete weir at the intake to the outlet works. The three gates are normally set at 0'-4'-0.1' allowing flows to pass over the weir and through the center gate. If the pool stage falls below the weir during periods of low flow, releases can be made by one of the side gates.

b. Flood Periods. The Westville project is operated in concert with other projects in the basin to reduce downstream flooding along the Quinebaug. Operations for flood may be considered in three phases: Phase I - appraisal of storm and river conditions during the development of a flood, Phase II - flow regulation and storage of flood runoff at the reservoir and Phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in the Master Water Control Manual for the Thames River Basin.

c. Regulating Constraints

(1) Minimum Releases. A minimum release of about 15 cubic feet per second (cfs) or 10 million gallons per day (mgd) is maintained during periods of flood regulation in order to sustain downstream fish life.

(2) Maximum Releases. The maximum non-damaging discharge capacity of the channel immediately downstream from Westville Lake is

about 1,600 cfs. Releases at or near this rate can be expected whenever reservoir inflows exceed this value and meteorological and hydrologic conditions permit.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 31 New England Division flood control dams, and continually monitors rainfall, snowcover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is the south-central portion of Massachusetts, including portions of Worcester, Hampden, and Middlesex counties. Table 1 contains information about public water supplies in the area based on information provided by the Massachusetts Department of Environmental Management. Of the 36 communities in the study area, 31 are served by public systems. No data is available for those communities dependent on private supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Westville Lake which could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of normal, future water supply demands were not developed because this study addresses only modifications in the regulation procedures at Westville Lake in order to provide short-term storage for water supply purposes when severe drought conditions exist.

c. South-Central Massachusetts Water Suppliers. Information pertaining to water suppliers is given in table 1. The data given for each water supplier includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1980, estimated safe yield of

TABLE 1

MAJOR WATER SUPPLIERS - SOUTH CENTRAL MASSACHUSETTS

Company or Agency	Town Served	Est. Population Served -1980	Source of Supply (SW or GW)	1980 Demands Avg. Day (MGD)	1980 Demands Max. Day (MGD)	Safe Yield (MGD)	Comments
Elm Hill Water District	Auburn	600	GW	1.07	1.80	2.5	Supplied by Worcester(SW/GW)
Auburn Water District		9,501		0.027	0.041		6 wells
Woodland Water District		540					Supplied by Worcester(SW/GW)
Blackstone Water Dept.	Blackstone	6,158	GW	0.37	0.63	0.78	2 Wells, 1 standby
	Brimfield		No Public Water Supply				
Brookfield Water Dept.	Brookfield	1,400	GW	0.078	0.117	0.40	3 Wells
	Charlton		No Public Water Supply				
Douglas Water Dept.	Douglas	2,611	GW	0.18	0.46	0.50	1 wellfield, 1 well
Dudley Water Dept.	Dudley	5,840	GW	1.2	1.81	1.0	1 wellfield, 1 well
East Brookfield Water Dept.	E. Brookfield	1,200	GW	0.12	0.292	0.9	1 well
Mass. American Water Co.	Grafton	5,332	GW	0.64	1.02	2.0	4 wells
South Grafton Water Dist.		2,810	GW	0.18	0.24	0.55	2 wells
	Holland		No Public Water Supply				
Hopedale Water District	Hopedale	2,226	GW	0.38	0.42	0.42	wellfield
						0.10	Milford Water Co.(SW/GW)
Hopkinton Water Dept.	Hopkinton	5,700	GW	0.571	0.837	1.11	3 wells
Leicester Water Supply Dist.	Leicester	2,700	GW	0.185	0.333	0.402	5 wells
Hillcrest Water Dist.		350	GW	0.154	0.175	0.236	3 wells
Cherry Valley & Rochdale W.D.		4,400	SW	0.32	0.70	0.375	Henshaw Pond
Milford Water Co.	Mendon	450	SW/GW				Included in Milford Syst.
Milford Water Co.	Milford	27,607	SW/GW	2.54	3.81	3.00	1.40 SW - Echo Lake 1.60 GW - wells Includes Mendon - 450 served Hopedale - 1667 served
Mass. American Water Co.	Milbury	5,366	GW	1.16	1.62	3.11	4 wells
Oakwood Heights Water Dist.		200		0.0074	0.011		Mass. American Water Co.
Maple Hillside Water Dist.		311		0.018	0.028		Mass. American Water Co.
	Millville		No Public Water Supply				

TABLE 1 (Cont'd)
MAJOR WATER SUPPLIERS - SOUTH CENTRAL MASSACHUSETTS

Company or Agency	Town Served	Est. Population Served - 1980	Source of Supply (SW or GW)	1980 Demands Avg. Day (MGD)	1980 Demands Max. Day (MGD)	Safe Yield (MGD)	Comments
Monson Water Dept.	Monson	5,000	GW	0.95	1.70	1.73	2 wells, 1 standby
North Brookfield Water Dept.	N. Brookfield	3,600	SW	0.47	1.13	2.50	North Pond
Whitinsville Water Co.	Northbridge	10,340	GW	1.14	1.65	2.55	2 wellfields, 1 emergency
Oxford Water Co.	Oxford	6,070	GW	0.702	1.163	2.0	3 wells
Palmer Fire District	Palmer	5,300	SW/GW	0.62	1.00	0.90	0.65 - 2 wells, 0.25 - Graves Brk. Res.
Bondsville Fire & Water Dist.		2,516	GW	0.274	0.46	0.50	3 wells
Three Rivers Fire Dist.		3,377	GW	0.32	0.52	0.58	2 wells
Thorndike Fire & Water Dist.		1,316		0.144	0.25		From Bondsville supply
Shrewsbury Water Dept.	Shrewsbury	20,407	GW	2.56	4.44	4.18	2 wells, Worcester system
Southbridge Water Supply Co.	Southbridge	16,665	SW	1.71	2.56	2.95	4 reservoirs
Spencer Water Dept.	Spencer	5,000	SW/GW	0.37	0.55	1.30	1.0 - 1 well, 0.30 - Shaw Pond
Sturbridge Water Dept.	Sturbridge	3,884	GW	0.674	1.	1.22	2 wells
Manchaug Water Dist.	Sutton	850	GW	0.016		0.045	3 wells
Wilkinsonville Water Dist.		400	GW	0.10		0.282	1 well
Upton Water Dept.	Upton	2,215	GW	0.23	0.36	0.69	1 well, 1 wellfield
Uxbridge Water Dept.	Uxbridge	5,600	GW	0.67	0.97	2.1	3 wells
	Wales		No Public Water Supply				
Ware Water Dept.	Ware	7,200	GW	0.92	1.12	1.58	4 wells
West Warren Water Dist.	Warren	1,078	GW	0.3	0.6	0.60	1 well, 1 standby
Warren Water Dist.		2,644	GW	0.19	0.30	0.35	5 wells
Webster Water Dept.	Webster	14,200	GW	1.29	1.94	3.50	2 wells & wellfield
W. Brookfield Water Dept.	W. Brookfield	2,200	GW	0.25	0.52	0.58	2 wells
Westborough Water Dept.	Westborough	13,346	SW/GW	2.02	2.5	2.78	0.75 - Westborough Res. 2.03 - 5 wells
Worcester DPW	Worcester	161,799	SW/GW	25.67	35.90	29.0	26.80 - reservoir system 2.20 - wells (2)

Table 2

Population Projections - South Central Massachusetts

Town	Actual 1980	1985	1990	1995	2000	Percent Change 1980-2000
Auburn	14,845	15,050	15,250	15,475	[illegible]	[illegible]
Blackstone	6,570	6,725	6,825	6,925	7,025	6.9
Brimfield	2,318	2,508	2,681	2,794	2,873	[illegible]
Brookfield	2,397	2,575	2,625	2,675	2,750	14.7
Charlton	6,719	7,050	7,500	7,675	8,075	20.2
Douglas	3,730	3,850	3,925	4,100	4,200	12.6
Dudley	8,717	9,050	9,200	9,400	9,725	11.6
East Brookfield	1,955	2,050	2,150	2,200	2,300	17.6
Grafton	11,238	11,450	11,750	11,975	12,175	8.3
Holland	1,589	1,902	2,193	2,430	2,578	62.2
Hopedale	3,905	4,000	4,125	4,150	4,200	7.6
Hopkinton	7,114	8,300	9,400	9,700	10,000	40.6
Leicester	9,446	9,600	9,700	9,950	10,075	6.7
Mendon	3,108	3,350	3,450	3,625	3,725	19.9
Milford	23,390	24,700	26,000	26,300	26,600	13.7
Millbury	11,808	12,175	12,450	12,725	12,925	9.5
Millville	1,693	1,750	1,800	1,825	1,875	10.8
Monson	7,315	7,688	8,026	8,427	8,823	20.6
North Brookfield	4,150	4,225	4,300	4,325	4,375	5.4
Northbridge	12,246	12,450	12,650	12,950	13,225	8.0
Oxford	11,680	12,100	12,350	12,725	12,925	10.7
Palmer	11,389	11,731	12,048	12,265	12,424	9.1
Shrewsbury	22,674	23,650	24,225	24,925	25,400	12.0
Southbridge	16,665	16,775	16,875	16,975	17,125	2.8
Spencer	10,774	11,200	11,600	12,025	12,225	13.5
Sturbridge	5,976	6,325	6,575	6,725	6,975	16.7
Sutton	5,855	6,350	6,725	6,950	7,225	23.4
Upton	3,886	4,125	4,225	4,425	4,525	16.4
Uxbridge	8,374	8,575	8,675	8,750	8,850	5.7
Wales	1,177	1,326	1,475	1,596	1,671	42.0
Ware	8,953	9,311	9,600	9,782	9,939	11.0
Warren	3,777	3,800	3,850	3,975	4,025	6.6
Webster	14,480	14,625	14,875	15,100	15,200	5.0
West Brookfield	3,026	3,100	3,150	3,175	3,250	7.4
Westborough	13,619	14,275	14,825	15,625	16,050	17.9
Worcester	161,799	161,800	161,800	161,800	161,800	0.0
TOTAL	448,357	459,516	468,873	476,444	482,910	7.7

of the source, and any further information available on the source of supply. An analysis of the adequacy of existing sources during drought conditions has not been performed.

d. Population Projections. Population projections for communities in south-central Massachusetts are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The projections were developed by the Massachusetts Office of State Planning for the "208" Areawide Wastewater Management Program, and updated in 1981. This information indicates areas of potential future growth in the south-central Massachusetts area.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 directs field offices to determine the short-term water supply capability of existing Corps reservoirs that would be functional under existing authorities. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purpose.

b. Drought Contingency Storage. It has been determined that a portion of the existing flood control storage at Westville Lake could be utilized for emergency drought contingency storage without having an adverse impact on the project's flood control function. Storage could be made available to a pool elevation of about 534 feet NGVD (19-foot stage), representing a total volume of about 475 acre-feet, equivalent to 155 million gallons or about 4 percent of the total reservoir storage. This volume is comprised of 100 acre-feet of permanent storage, and 375 acre-feet of flood control storage. The 375 acre-feet represents an infringement of about 0.22 inches of runoff on the flood control storage.

The American Optical Company is a riparian user of Quinebaug River waters just downstream of Westville Lake in Southbridge, and that company owns 1,190 acre-feet of storage in the Corps East Brimfield

Reservoir, located upstream of Westville Lake. The company uses the storage to augment riverflows for industrial use during the period of 30 June to 31 December. It is, therefore, unlikely that drought contingency storage could be filled at Westville during the summer season without impacting the American Optical Company's water needs. The opportune time to fill the drought contingency storage at Westville, in anticipation of a possible later drought condition, would be during the late spring runoff period.

An all-season low flow duration analysis was performed using 19 years of flow records, 1964-1982, for the gaging station on the Quinebaug River at Westville. Based on this analysis, it was determined that during a 10-year frequency drought period the volume of runoff could: a) fill the reservoir from elevation 525 to 534 feet in an 11-day summer period provided no releases were made at the dam, or b) fill the reservoir to elevation 534 in a 31-day summer period, if a continuous release of about 10 cfs (0.10 cfs/sq. mi., csm) were maintained. Drought contingency storage versus flow duration at Westville, is graphically shown on plate 4.

The Westville reservoir could be filled to elevation 534 in about a one-week period in May while continuously releasing about 20 cfs. The stored water could be later drawn directly from the reservoir or released downstream for municipal supply with proper treatment.

c. Effects of Regulated Flows. As discussed, the curtailment of flows from Westville Lake during a drought emergency could adversely impact on the flowage rights of downstream riparian users. At this time, however, it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that when a specific drought emergency situation does occur, the various legal implications would have to be weighed.

9. WATER QUALITY EVALUATION

a. Water Quality Classification. The entire length of the Quinebaug River in Massachusetts is rated class B by the Massachusetts Division of Water Pollution Control. Class B waters are designated for the protection and propagation of fish, other aquatic life and wildlife;

and for primary and secondary recreation. Public water supp treatment, is not one of the uses given in the Massachusetts Quality Standards for class B waters. However, a water whicl class B standards could be made potable with standard treatm processes.

The Quinebaug River within the boundaries of the Westvil project has also been designated a cold water fishery. Techı requirements for class B cold water fisheries include a minii oxygen concentration (DO) of 6 mg/l, a maximum temperature o pH in the range of 6.5-8.0 standard units and fecal coliform not to exceed a log mean of 200 per 100 ml for a set of samp not more than 10 percent of the total samples shall exceed 4 ml during any monthly sampling period and the waters shall b from pollutants in concentrations that exceed the most sensi receiving water use.

b. Existing Water Quality. Westville Lake has generall water quality but does not fully meet the requirements of it setts class B designation. Principal concerns are low pH lev color levels, occasional low DO concentrations and high coli counts, and high nutrients levels. The low pH and high colo are due to natural conditions in the watershed; the high col counts and high nutrient levels are due to runoff from devel and effluent from the one significant point-source discharge watershed - the Sturbridge Wastewater Treatment Plant. The levels occasionally observed are due to a combination of nat watershed conditions and runoff from developed areas.

Although nutrient levels in Westville Lake are relativel the lake experiences only rare and short-lived algae blooms of its small size and its correspondingly short reservoir de time. The latter also causes Westville Lake to stratify onl during the summer. The maximum surface-to-bottom temperatur is 4 or 5F°. The use of a weir to maintain the pool causes surface waters to be discharged thus reducing the temperatur in the lake while increasing the downstream temperature. Th partially offset by partially opening one of the side gates. temperature increase between the inflow and the discharge is typically 1F°.

DO levels are high throughout most of the lake but decrease to low - but usually not anaerobic - conditions at the lake bottom.

c. Water Quality Requirements for Drought Storage. There are two water quality requirements to be met for drought storage. The waters must meet state standards for surface waters and must be of a quality suitable for the water supply user. A water which meets class B standards could be made usable for public water supply without unusual standard treatment processes; the water quality required for industrial water supply depends on the industrial process involved. The water at Westville Lake would always be of a quality suitable for fire-fighting.

d. Effects of Drought Storage. Increasing the size of the permanent pool at Westville Lake for drought storage will cause additional water quality problems in the lake. These problems will not preclude the water's use for water supply but will mean that additional treatment will be required. These problems will also interfere with the recreational use of the lake.

The proposed larger pool will inundate an additional 37 acres of land. The decay of organic material on the land will increase the duration and extent of anaerobic conditions in the depths of the lake. Under the effects of anaerobiasis, iron and manganese, inorganic nitrogen and phosphorus will be converted to soluble forms and their concentrations in the lake will increase. Increased iron and manganese will require additional, but not unusual, treatment before the water can be used for public water supply. Increased levels of nitrogen and phosphorus combined with the increased reservoir detention time due to a larger pool will allow the formation of nuisance algae blooms in the lake. These blooms would interfere with the recreational uses of the lake and add difficult-to-remove color, taste and odor to the water.

A second problem would be a change in the thermal regime of the lake and the downstream discharge. A larger pool would exhibit stronger stratification. This plus the change to a gate-controlled bottom discharge - which releases the cooler deeper waters - will increase the surface temperature of the lake, possibly to the point that the existing cold-water fishery in the lake would be changed to a warm-water fishery.

Because releases would be made from a gate at the bottom of the pool, temperatures of the discharge will probably not differ much from existing temperatures.

e. Water Quality Conclusions. If the pool at Westville Lake is increased to provide drought storage, the water quality would be degraded by levels of iron, manganese, color, taste, and odor which would likely make it undesirable as a public water supply source. However, with standard treatment methods the water could made potable. The water might still be suitable for industrial water supply and would definitely be usable for fire-fighting.

Consideration should be given to the periodic monitoring of the quality of water at Westville Lake during times of drought storage.

10. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of a reservoir's storage volume might have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. An evaluation has been made of the impacts resulting from drought contingency storage on the flood control purpose of this project. Effects on recreation, sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources have also been addressed.

b. Flood Control. A review of the regulation procedures at Westville Lake was undertaken to determine the volume of water that could be made available for drought contingency purposes. The water would be stored by temporarily utilizing existing flood control storage. It is recognized that major floods occur in every season of the year, thus any use of flood control storage would be continually monitored to insure there would be no adverse impacts on downstream flood protection.

At Westville Lake the maximum pool elevation for drought contingency storage has been estimated to be elevation 534 feet, representing an infringement on the flood control storage of about 0.22 inches of runoff from the net drainage area below East Brimfield Lake of 32 square miles.

Based on a 10-year event, the anticipated rate of pool storage would exceed 0.3 foot per day over a 31-day period beginning in May. This condition assumes a flow of about 10 cfs (6.5 mgd) would be released downstream for the duration of the drought. The storage may be held for a period of one month or longer at the 534-foot elevation before withdrawal.

c. Recreation. The recreation area will be entirely isolated at a stage of 19 feet, and the ballfield and boat ramp will be underwater. As the water level rises, the boat ramp cannot be used at a stage of 14 feet, and the ballfield area will be flooded at stage 17. When the water level reaches the 17-foot stage, the recreation area will be closed.

d. Project Operations. Trees border approximately 3,000 feet of shoreline along the west side of the lake, and about 1,000 feet along the east side at a stage of 15 feet. The rate of mortality for various species of trees and shrubs increases substantially when the base of these trees and shrubs are flooded for extended periods during the growing season (May through September). It will be the user's responsibility to remove trees that die as a result of the proposed drought storage.

The concrete weir currently maintains a recreation pool at a stage of 10 feet with provisions for an increase to a stage of 12 feet with the use of stoplogs. To maintain a pool at the 19-foot stage while releasing a minimum flow would require gate adjustments. Since this procedure may require frequent gate settings specifically for drought storage, the added cost of labor will be the responsibility of the user.

e. Effect on the Aquatic Ecosystem. The main stem of the Quinebaug River, within the reservoir project limits, has been found to contain such warm water species as smallmouth bass, largemouth bass, bluegill, black crappies, yellow perch, chain pickerel, and brown bullhead. For fishing interest, brook, brown, and rainbow trout are stocked in the Quinebaug and in Hobbs and Breakneck Brooks by the Massachusetts Division of Fish and Game. Generally, the numbers stocked vary according to availability of the fish from the hatcheries after areas with high priority have been stocked. Depending on water levels and stock availability, fish may also be stocked in the fall. Generally, the Quinebaug River would be stocked with several thousand fish while the Hobbs River and Breakneck Brook would each receive a few hundred fish. The fish are

generally stocked in lengths of 9-12 inches. A program to revitalize the pike fishery was established, but it has proven difficult to assess the reproduction success of the pike as populations are low. The species of fish reported in Westville Lake include brook, brown and rainbow trout, northern pike, chain pickerel, white sucker, white perch, yellow perch, smallmouth and largemouth bass, brown bullhead, pumpkinseed, black crappie, bluegill, and golden shiner minnow.

An increase in the impoundment for the proposed contingency storage would temporarily raise the lake's water level by approximately nine feet during late summer-early fall and throughout the storage period. This would temporarily inundate small areas of shallow stream habitat, wetland areas and shoreline along the Quinebaug River and Hatchet Brook. The first five feet of rise along the shore would cover an area where vegetation was previously cleared. This additional amount of coverage represents approximately 4 percent of the area above the permanent pool that would be inundated during a flood reaching the spillway crest. The rise in pool elevation probably would not have more of a significant adverse effect than has occurred with past flood control operations. The increase in storage should not impact habitat or reproductive conditions of most warm water species (spawning generally occurs during spring and early fall).

Because of the generally steep topographic relief in the area, the rise in pool would not back-up significantly into the lake. Hobbs River and Breakneck Brook would be unaffected. The only stream aquatic site that would be affected would be a small area around the Hatchet Brook confluence with the main stem. An increase in the pool level would likely inundate a few acres of swamp marsh and, probably, red maple wetlands, In the summer months, ducks and Canadian geese frequent this area and appraently some are seen during the winter months because the stream maintains its flow and does not freeze over. The wetland areas along Hobbs Brook would not be affected. Should the contingency storage be required for prolonged periods, continuous use of the wetlands for ducks and geese could be jeopardized. The actual impacts and the potential for new wetlands to be created, would have to be assessed. It appears that no endangered or threatened species would be affected.

The water level fluctuations in the permanent pool acts to scour the littoral area. This would limit the shoreline vegetation, fish population, and impacts that might otherwise be associated with a rise in pool for a couple of months for drought contingencies.

f. Effects on the Terrestrial Environment. The project area has several forest types, but the principal ones near the permanent pool consist of white pine/northern red oak/white ash, sugar maple/beech/yellow birch, some red pine and red maple along Hatchet Brook. These areas would be relatively unaffected by the pool's increase for drought storage. Areas previously affected have been selectively cleared or cleaned of tree damages after previous inundations. The area most likely to be damaged during a temporary reserve storage would be the grass cover in the recreation area. Water storage over this area would likely kill the grass cover and would limit its recreational use for long periods until the damage could be repaired.

g. Effects on Wildlife. The project area around the permanent pool does not support a principally productive wildlife habitat. The upper reaches of the project area that contains a diversity of habitats would be unaffected by the rise in the permanent pool for drought contingency storage. Overall, the opportunity for effective wildlife management in the project area is limited due to the shape of the area itself. Apart from the Hobbs Brook wetland area above the proposed contingency pool level, the project is basically a narrow (50-100-foot wide) corridor intersected by the Quinebaug River and flowing along both sides of it in high relief topography.

The wildlife population in the project area would in many cases consist of locally common species that are established in the adjacent woodlands. The territories of most species which have been traditionally identified have requirements which would move them in and out of the project area on a regular basis. Most of the wildlife activity would occur outside of the permanent pool, the area to be affected by a rise in the lake.

The mammals in the project area generally include beaver, otter, muskrat, fishes, mink, red and gray fox, eastern cottontail, woodchuck, porcupine, eastern chipmunk, red and gray squirrel, raccoon and occasional white-tailed deer. No significant impact to these animals would occur as a result of operating the drought contingency storage.

h. Historic and Archaeological Resources. Although there are no recorded prehistoric archaeological sites within the impact area, this is more likely due to lack of a systematic survey to locate such sites,

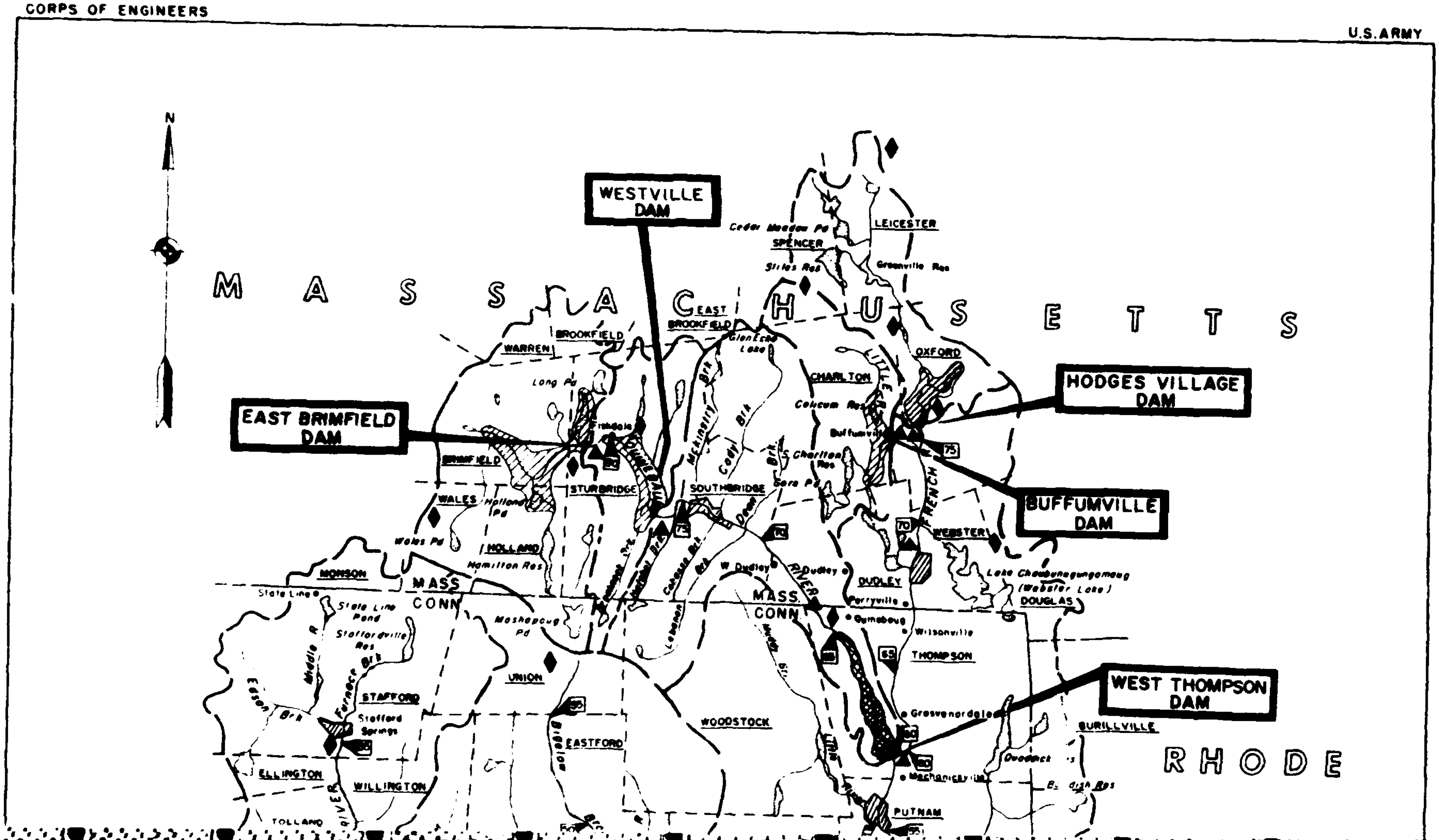
rather than their actual absence. A drought contingency pool at elevation 534 feet NGVD would inundate much of the site of Westville Village, a 19th century industrial village. Sites of a shuttle factory, sawmill, blacksmith shop, store, and several dwellings and related outbuildings would be affected.

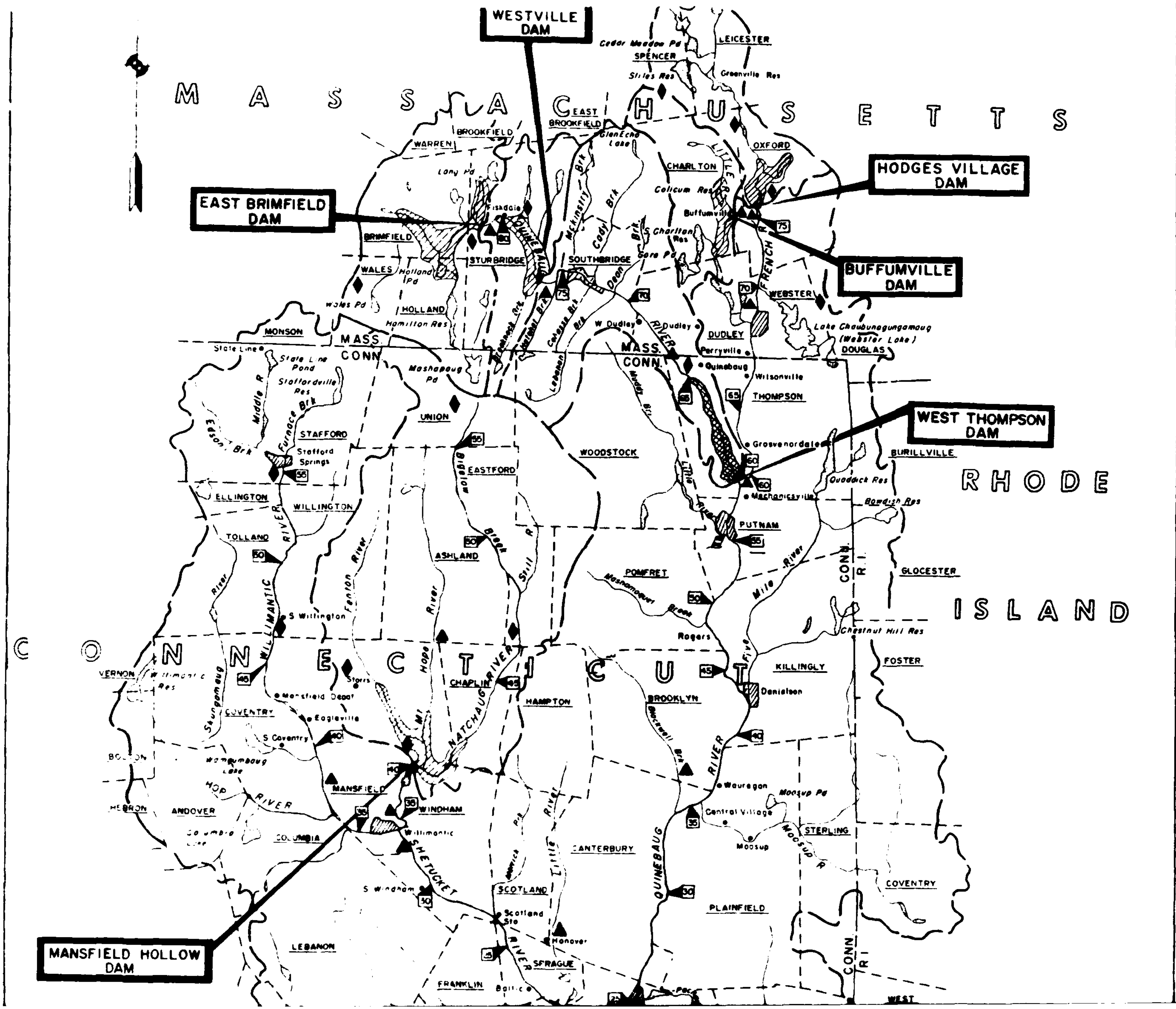
11. SUMMARY AND CONCLUSIONS

Hydrologic studies indicate it would be possible to provide up to approximately 475 acre-feet, equivalent to 155 million gallons, of reservoir storage for drought emergency purposes without having a significant adverse impact on the project's flood control effectiveness. An evaluation of the effects of this drought contingency plan on the various other project features, as well as certain environmental aspects, has revealed some impacts. The water quality would be degraded by levels of iron, manganese, color, taste, and odor which would likely make it undesirable as a public water supply source. However, with standard treatment methods the water could be made potable. Without treatment, the water might still be suitable for industrial water supply and would definitely be usable for fire-fighting purposes.

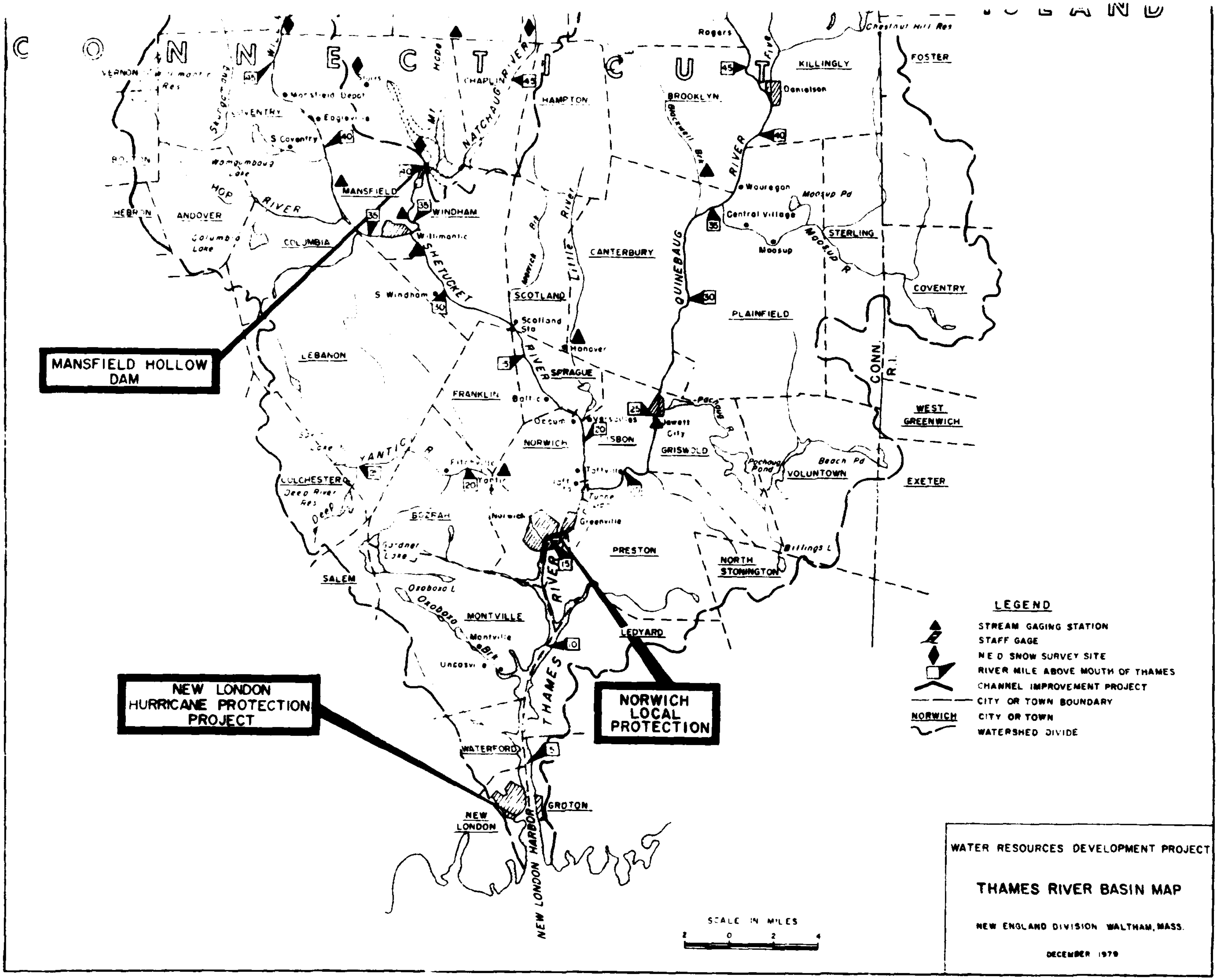
CORPS OF ENGINEERS

U.S. ARMY





MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
WESTVILLE DAM
EAST BRIMFIELD DAM
HODGES VILLAGE DAM
BUFFUMVILLE DAM
WEST THOMPSON DAM
MANSFIELD HOLLOW DAM
LEICESTER
SPENCER
EAST BROOKFIELD
BROOKFIELD
WARREN
CHARLTON
OXFORD
BRIMFIELD
STURBRIDGE
SOUTHBRIDGE
WALES
HOLLAND
WEBSTER
DUDLEY
DOUGLAS
MONSON
UNION
THOMPSON
WOODSTOCK
STAFFORD
EASTFORD
BURRILLVILLE
ELLINGTON
WILLINGTON
PUTNAM
TOLLAND
ASHLAND
POMFRET
GLOCESTER
KILLINGLY
FOSTER
VERNON
CHAPLIN
HAMPTON
BROOKLYN
COVENTRY
MANSFIELD
WINDHAM
BOLTON
HEBRON
ANDOVER
COLUMBIA
CANTERBURY
STERLING
SCOTLAND
PLAINFIELD
LEBANON
SPRAGUE
FRANKLIN
MASS.
CONN.
R.I.
QUINEBAUG RIVER
FRENCH RIVER
LITTLE R.
WILLIMANTIC RIVER
NATCHAUG RIVER
SHETUCKET RIVER
HOP RIVER
FIVE MILE RIVER
MOOSUP R



CONNECTICUT
MANSFIELD HOLLOW DAM
NEW LONDON HURRICANE PROTECTION PROJECT
NORWICH LOCAL PROTECTION
CONN.
R.I.
LEGEND
STREAM GAGING STATION
STAFF GAGE
N E D SNOW SURVEY SITE
RIVER MILE ABOVE MOUTH OF THAMES
CHANNEL IMPROVEMENT PROJECT
CITY OR TOWN BOUNDARY
NORWICH
CITY OR TOWN
WATERSHED DIVIDE
SCALE IN MILES
2 0 2 4
WATER RESOURCES DEVELOPMENT PROJECT
THAMES RIVER BASIN MAP
NEW ENGLAND DIVISION WALTHAM, MASS.
DECEMBER 1979
KILLINGLY
FOSTER
BROOKLYN
HAMPTON
CHAPLIN
MANSFIELD
WINDHAM
ANDOVER
HEBRON
COLUMBIA
CANTERBURY
STERLING
COVENTRY
PLAINFIELD
SCOTLAND
LEBANON
SPRAGUE
FRANKLIN
NORWICH
GRISWOLD
VOLUNTOWN
WEST GREENWICH
EXETER
COLCHESTER
BOZRAH
PRESTON
NORTH STONINGTON
SALEM
MONTVILLE
LEDYARD
WATERFORD
GROTON
NEW LONDON
QUINEBAUG RIVER
SHETUCKET RIVER
THAMES RIVER
NEW LONDON HARBOR
NATCHAUG RIVER
HOP RIVER
YANTIC R
Moosup R
Little River
Danielson
Central Village
Moosup
Wauregan
Willimantic
S Windham
Scotland Sta
Hanover
Baltic
Occum
Jewett City
Greenville
Uncasville
Montville
Rogers
Chestnut Hill Res
Moosup Pd
Beach Pd
Pachaug Pond
Billings L
Columbia Lake
Gardner Lake
Oxoboxo L
Deep River Res
Mansfield Depot
Eagleville
S Coventry

PLATE I

WESTVILLE RESERVOIR
AREA AND CAPACITY
DRAINAGE AREA: (NET) 32.0 Sq. Mi.
(GROSS) 99.5 Sq. Mi.

ELEV. M.S.L.	STAGE FEET	AREA ACRES	CAPACITY AC. FT.	CAPACITY INCHES
Permanent Storage				
515	0	3	0	0
516	1	3	3	0
517	2	4	7	0
518	3	5	12	0
519	4	6	18	0.01
520	5	7	25	.01
521	6	9	34	.02
522	7	12	46	.03
523	8	15	61	.04
524	9	19	79	.05
525	10	23	100	.06
Flood Control Storage				
525	10	23	0	0
526	11	27	25	0.01
527	12	31	54	.03
528	13	35	87	.05
529	14	39	124	.07
530	15	44	165	.10
531	16	48	210	.12
532	17	52	260	.15
533	18	56	315	.18
534	19	60	375	.22
535	20	64	435	.25
536	21	67	500	.29
537	22	69	570	.33
538	23	71	640	.37
539	24	73	710	.42
540	25	76	785	.46
541	26	79	860	.50
542	27	82	940	.55
543	28	85	1020	.60
544	29	88	1110	.65
545	30	91	1200	.70

ELEV. M.S.L.	STAGE FEET	AREA ACRES	CAPACITY AC. FT.	CAPACITY INCHES
546	31	94	1290	0.76
547	32	97	1390	.81
548	33	99	1490	.87
529	34	101	1590	.93
550	35	104	1690	.99
551	36	108	1800	1.05
552	37	116	1920	1.12
553	38	127	2050	1.20
554	39	141	2190	1.28
555	40	160	2340	1.37
556	41	184	2510	1.47
557	42	212	2710	1.59
558	43	244	2950	1.73
559	44	286	3230	1.89
560	45	326	3560	2.09
561	46	375	3900	2.28
562	47	425	4300	2.52
563	48	470	4750	2,78
564	49	520	5240	3.07
565	50	568	5790	3.39
566	51	620	6380	3.74
567	52	670	7030	4.12
568	53	720	7720	4.52
569	54	770	8470	4.96
570	55	819	9260	5.42
571	56	866	10100	5.92
572	57	913	11000	6.44

NOTES: Gate Sill Elev. = 515.0
Spillway Crest Elev. = 572.0
1" Runoff = 1,700 A.F.

PERTINENT DATA
WESTVILLE LAKE

LOCATION	Quinebaug River, Southbridge and Sturbridge, Massachusetts
DRAINAGE AREA	99.5 square miles (gross); 32.1 square miles (net)
STORAGE USES	Flood control, Recreation

RESERVOIR STORAGE

	Elevation (ft msl)	Stage (feet)	Area (acres)	Capacity: Acre-Feet	Capacity: Inches on Drainage Area
Inlet Elevation	515.0	0.0	-	-	-
[illegible]	525.0	10.0	23	100	0.06
Spillway Crest	572.0	57.0	913	11,000 (net)	6.44 (net)
Maximum Surcharge	582.1	67.1	1,650	-	-
Top of Dam	587.0	72.0	-	-	-

EMBANKMENT FEATURES

Type	Rolled earth fill with rock protection
Length (ft)	560
Top Width (ft)	25
Top Elevation (ft msl)	587.0
Height (ft)	78
Volume (cy)	208,000

SPILLWAY

Location	Left (north) abutment
Type	Chute spillway/concrete ogee weir
Crest Length (ft)	200.0
Crest Elevation (ft msl)	572.0
Surcharge (ft)	10.1
Maximum Discharge Capacity (cfs)	24,500
Spillway Design Flood	
Peak Inflow (cfs)	38,400
Peak Outflow (cfs)	24,500

OUTLET WORKS

Type	Three rectangular conduits through spillway section
Tunnel Inside Diameter (ft)	4.0 wide x 6.0 high
Tunnel Length (ft)	63
Service Gate Type	Electrically controlled slide
Service Gate Size (ft)	4.0 wide x 6.0 high
Emergency Gate Type	Stop logs only
Downstream Channel Capacity (cfs)	1,600
Maximum Discharge Capacity with Pool at Spillway Crest Elev.(cfs)	3,750
Stilling Basin	None
Weir	Control weir at center gate

PERMANENT POOL

Length (ft)	3,260
Shoreline Length (ft)	8,800
Area (acres)	22

LAND ACQUISITION

	Elevation (ft msl)	Stage (feet)	Area (acres)
Fee Taking	563	48	578
Easement	575	60	504
Clearing	530	15	44

MAXIMUM POOL OF RECORD

Date	March 1968
Stage (ft)	49.0
Percent Full	48

UNIT RUNOFF

One Inch Runoff (acre-feet)	1,700

OPERATING TIME

Open/Close Each Gate	6 minutes (manual operation: 80 turns/inch)

PROJECT COST

Through September 1977	$5,685,000

DATE OF COMPLETION	1962
MAINTAINED BY	New England Division, Corps of Engineers

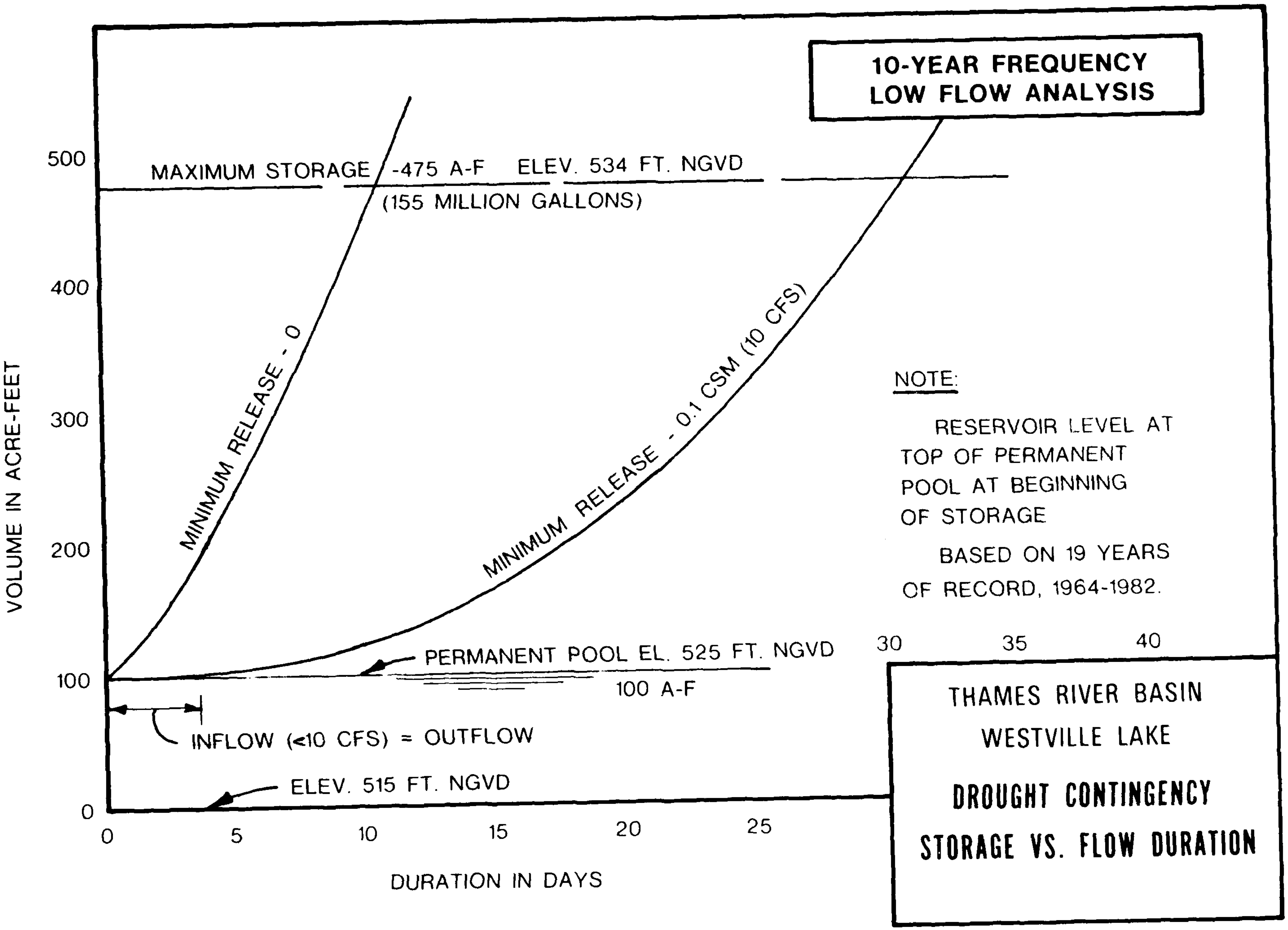

10-YEAR FREQUENCY
LOW FLOW ANALYSIS
MAXIMUM STORAGE -475 A-F ELEV. 534 FT. NGVD
(155 MILLION GALLONS)
MINIMUM RELEASE - 0
MINIMUM RELEASE - 0.1 CSM (10 CFS)
NOTE:
RESERVOIR LEVEL AT TOP OF PERMANENT POOL AT BEGINNING OF STORAGE
BASED ON 19 YEARS OF RECORD, 1964-1982.
PERMANENT POOL EL. 525 FT. NGVD
100 A-F
INFLOW (<10 CFS) = OUTFLOW
ELEV. 515 FT. NGVD
RESERVOIR STORAGE / INFLOW
VOLUME IN ACRE-FEET
DURATION IN DAYS
0
100
200
300
400
500
0
5
10
15
20
25
30
35
40
THAMES RIVER BASIN
WESTVILLE LAKE
DROUGHT CONTINGENCY
STORAGE VS. FLOW DURATION

PLATE 4

END

FILMED

9-84